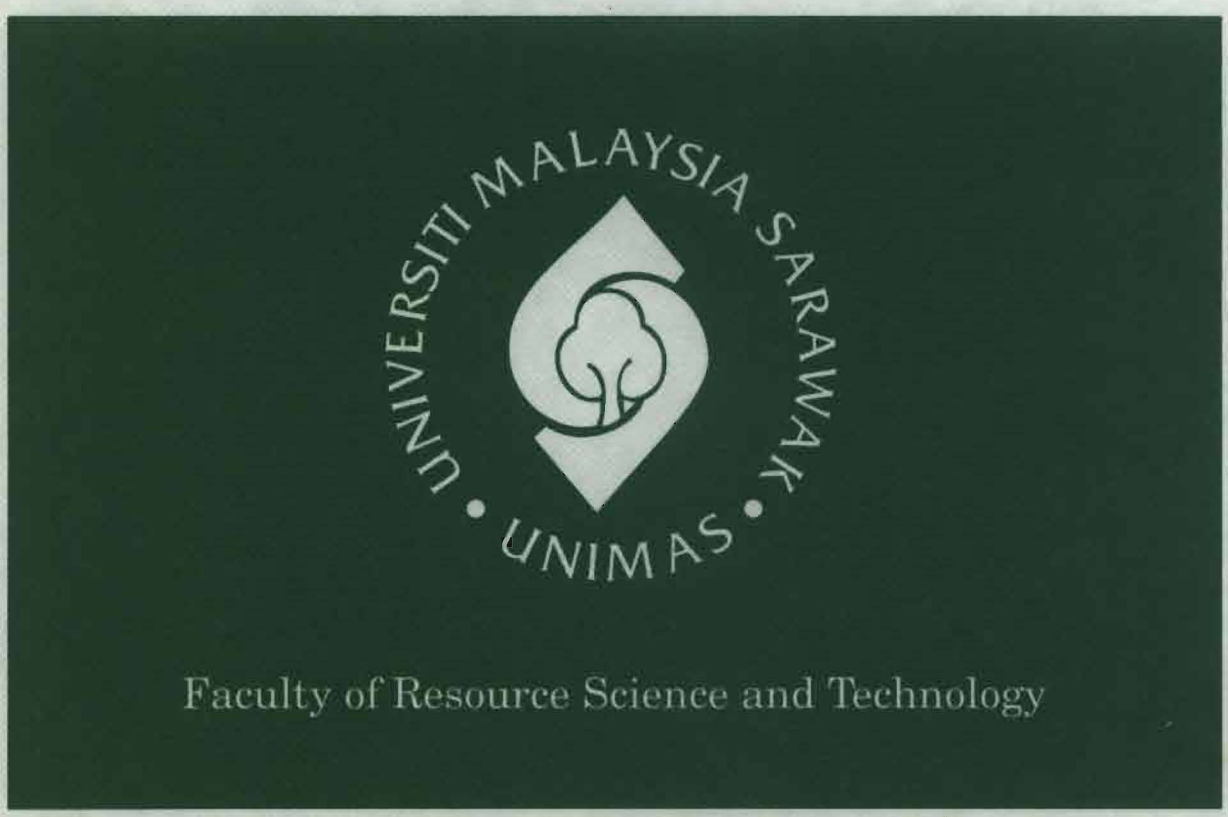

FAUNISTIC COMPOSITION OF BUTTERFLIES (LEPIDOPTERA: RHOPALOCERA) ON PULAU SATANG BESAR AND KUBAH NATIONAL PARK, SARAWAK

Catherine Lee Sie Hwan

Bachelor of Science with Honours
(Animal Resource Science and Management)
2007

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CATHERINE LEE SIE HWAN

This project is submitted in partial fulfillment of the requirements for the degree of
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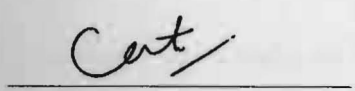
DECLARATION

No portion of the work referred to in this dissertation has been submitted in support of an application for another degree of qualification of this or any other university or institution of higher learning.



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Faunistic Composition of Butterflies (Lepidoptera: Rhopalocera) on Pulau Satang Besar and Kubah National Park, Sarawak

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ABSTRACT

A study on the faunistic composition of butterflies (Lepidoptera: Rhopalocera) was carried out on Pulau Satang and Kubah National Park, Sarawak in August, September and December, 2006. Overall, a total of 112 species and 369 individuals were collected. Of these, 35 species and 157 individuals from five families were sampled on Pulau Satang Besar while 86 species from 212 individuals were captured at Kubah National Park. Kubah National Park is more speciose in terms of its butterfly composition as compared to Pulau Satang Besar. The butterfly fauna on both Pulau Satang Besar and Kubah National Park are generally not similar in species composition. Only a total of seven species are found at both study sites. Lycaenidae (13 species) was the most speciose family on Pulau Satang Besar while Nymphalidae (72 individuals) represented the most abundant family. In Kubah National Park, Nymphalidae also represented both the most speciose (42 species; 110 individuals) as well as abundant family sampled during this study. The most abundant species on Pulau Satang Besar was *Ideopsis juventa sitah* (46 individuals) while *Ypthima pandocus sertorius* (26 individuals) was the most abundant in Kubah National Park. *Ideopsis juventa sitah*, a nymphalid species from Pulau Satang is now reported for the first time for Borneo. Two rare butterfly species were also recorded in this study, namely *Papilio iswara araspes* (Papilionidae) and *Eurema simulatrix tecmessa* (Pieridae) while one endemic species, *Paralaxita nicevillei* was collected at Kubah National Park. The papilionid, *Troides helena mosyclus*, a protected species listed in CITES (Appendix II) was also found on Pulau Satang Besar. The butterfly composition on both Pulau Satang and Kubah National Park is further discussed.

Keywords: island, butterfly, species composition, Pulau Satang Besar, Kubah National Park

ABSTRAK

Satu kajian komposisi fauna kupu-kupu di Pulau Satang Besar dan Taman Negara Kubah, Sarawak telah dijalankan pada bulan Ogos, September dan Disember, 2006. Secara keseluruhan, 112 spesies dan 369 individu telah dikumpul. Daripada jumlah tersebut, 35 spesies dan 157 individu dari lima famili telah disampel di Pulau Satang Besar manakala 86 spesies dari 212 individu telah diperolehi di Taman Negara Kubah. Dari segi komposisi spesies, Taman Negara Kubah didapati lebih tinggi kepelbagaian spesiesnya dari Pulau Satang Besar. Fauna kupu-kupu di kedua-dua tempat, Pulau Satang Besar dan Taman Negara Kubah secara amnya tidak sama dari segi komposisi spesies. Hanya sejumlah tujuh spesies telah dijumpai di kedua-dua tempat kajian. Lycaenidae (13 spesies) ialah famili yang paling tinggi kepelbagaiannya di Pulau Satang Besar sementara Nymphalidae (72 individu) menunjukkan famili yang paling tinggi dari segi kelimpahan. Di Taman Negara Kubah, Nymphalidae juga merupakan famili yang paling pelbagai (42 spesies; 110 individu) dan melimpah dalam kajian ini. Spesies yang paling melimpah di Pulau Satang Besar ialah Ideopsis juventa sitah (46 individu) manakala Ypthima pandocus sertorius (26 individu) merupakan spesies yang paling melimpah di Taman Negara Kubah. Ideopsis juventa sitah, spesies nymphalid dari Pulau Satang Besar telah direkod buat kali pertama di Borneo. Dua spesies langka juga telah direkod dalam kajian ini, Papilio iswara araspes (Papilionidae) dan Eurema simulatrix tecmessa (Pieridae) sementara satu spesies yang endemik, Paralaxita nicevillei telah didapati di Taman Negara Kubah. Papilionid, Troides helena mosyclus, spesies yang dilindungi dan disenaraikan dalam CITES (Appendik II) juga telah dijumpai di Pulau Satang Besar. Perbincangan tentang komposisi kupu-kupu di Pulau Satang Besar dan Taman Negara Kubah akan juga disertakan.

***Kata kunci**: pulau, kupu-kupu, komposisi spesies, Pulau Satang Besar, Taman Negara Kubah*

1.0 INTRODUCTION

Butterflies (Lepidoptera: Rhopalocera) are specialized herbivorous insects that feed on specific host plant during the larval stage (Whittaker, 1998). These highly plant-dependent insects are sensitive to the alteration in their environment such as changes of light, humidity and temperature (Tamblyn *et al.*, 2005). They are considered as good bioindicators of conservation value as they are associated with a broad spectrum of ecological niches (Samway, 1994). Thus, butterflies are among the best known insects for examining patterns of terrestrial biodiversity and distribution due to their instant response to environmental stress.

The large tropical rainforest of Borneo Island consist of a rich diversity of flora and fauna (Mohamedsaid and Holloway, 1999). The geological and climate in Borneo has led to speciation and great species diversity (MacKinnon *et al.*, 1996). As a result, the Bornean rainforests eventually accommodate a tremendously high Lepidopteran diversity (Abang and Karim, 2005). In Borneo, there are 950 species of butterflies (Otsuka, 2001) while according to Abang (2003) based on voucher specimens, 731 species of butterflies had been recorded in Sarawak. Although the butterfly fauna of Borneo can be regarded as completely well documented, much study is still needed in habitats that have not been yet surveyed (F. Abang, *per. comm.*). An island is one such habitat.

Islands perhaps can be categorized into oceanic islands and continental shelf islands (Whittaker, 1998). Oceanic islands are islands that have never been connected to the

continental land masses whereas continental shelf islands are islands that were once connected to the mainland during the lower sea levels period (Whittaker, 1998). However, Sarawak mainly comprises continental shelf islands.

Continental shelf islands were actually joined to the mainland during the last glacial maximum in about 20,000 years ago when the sea level was about 80m lower (MacDonald, 2003). At that time, the butterfly fauna on these islands may probably similar to the mainland. In between 15,000 to 6,000 years ago, the risen of the sea level had caused islands to be separated from the mainland (MacDonald, 2003). When the butterfly populations on the continental shelf islands separated from the larger mainland populations, isolation processes happenned. The isolation processes of butterfly species began when the available ecological space was filled to a large extend (Gillespie and Roderick, 2002). Some species tend to be lost or reduce in number over the ecological time and with isolation in the relaxation stage (Gillespie and Roderick, 2002). Only a small fraction of the genetic variation derived from the parent population was present. As a result, the Rhopalocera fauna on the continental shelf islands therefore resembled those on the mainland to a certain extent (Cranbrook, 2000).

Therefore, the study of island is important prior to the emerging patterns of fundamental process, namely dispersal, invasion, competition, adaptation and extinction which are among the most difficult in biology to study and to understand (MacArthur and Wilson, 1969). In this study, Pulau Satang Besar represents as a continental shelf island, was chosen as it is relatively easier to access compared to

other islands within Sarawak as well as in considering that there is no documentation of the butterfly fauna on this island up to date.

Hence, the main aim of this study was to document butterfly composition on Pulau Satang Besar and the adjacent Kubah National Park on mainland Borneo. Apart from that, the objective was also to compare the butterfly faunistic composition between an island, Pulau Satang Besar and habitat island, Kubah National Park. Kubah National Park is a habitat island as this nature reserve was surrounded by recreational areas, villages and agricultural activities.

2.0 LITERATURE REVIEW

Butterflies are classified in the class of Insecta and together with moths they share the same order, Lepidoptera where 'Lepid' means scale and 'ptera' means wing (Romoser and Stoffolano, 1998). Bornean butterflies can be classified into five families, Papilionidae, Nymphalidae, Pieridae, Hesperiidae and Lycaenidae. According to Hutchins *et al.* (2004), butterflies occur on all land masses except in Antarctica. Most butterfly species live in tropical regions and particularly abundant in tropical rainforest (Fres, 1991). In Borneo, the number of butterfly species is related to the number of different biological plants within the region (Otsuka, 1988). According to Yates (1992), most Bornean butterflies remain hidden in the upper canopy where nectar bearing flowers occur whereas the rest would prefer living in open secondary forest. Hutchins *et al.* (2004) stated that the eggs, larvae and pupae are usually found in nearly all terrestrial habitats either on or near host plants. Lepidopterans are cold-blooded and usually bask themselves in the sun with wings outspread to warm them up (Fres, 1991). Feltwell (1993) mentioned that butterflies are regular migrants and engage in short-term migration. Pierids, Nymphalids, Lycaenids and Hesperiids are among the migratory butterflies (Hutchins *et al.*, 2004).

2.1 Previous Studies

A number of previous studies were conducted on islands to study the butterfly fauna. Table 1 shows a summary of previous studies of the butterfly fauna on offshore islands in Malaysia.

Table 1: A summary of previous studies of the butterfly fauna on offshore islands in Malaysia.

Author	Year	Study
Borneo		
Pendlebury and Museums	1931	Rhopalocera from Mangalum Island, North West Borneo
Zaidi and Salleh	1997	Butterflies from Banggi Island, Sabah (Lepidoptera: Rhopalocera)
Abang *et al.*	2004	A contribution to the butterfly fauna of the island of Balambangan (Malaysia, Sabah) (Insecta: Lepidoptera)
Abang and Page	2006	New subspecies of Papilionidae LATREILLE, (1802) from Sabah, Malaysia (Lepidoptera: Papilionidae)
Abang *et al.*	2006	A further contribution to the Lepidoptera fauna of Balambangan Island (Malaysia: Sabah)
Peninsular Malaysia		
Stubbs	1961	Some islands (Pulau Tioman, Pulau Pemanggil and Pulau Aur) races of butterflies and their conservation
Wilcocks	1969	Butterfly collecting on Pulau Langkawi
Pasteur	1972	More notes on butterfly collecting on Pulau Langkawi
Yeh	1972	New records of butterflies from Perak
Quek *et al.*	1999	New records of butterfly species for Pulau Tioman
Liow	1998	A note on the bird (Aves) and butterfly species (Lepidoptera) of Pulau Tulai, Pulau Sribuat-Sembilang and Pulau Pemanggil, Malaysia
Zaidi and Soh	2000	Butterflies (Lepidoptera: Rhopalocera) from Pulau Pinang, Terengganu
Turner *et al.*	2003	Malaysian reefs and islands conservation project 2003 Report of the terrestrial pilot phase
Tamblyn *et al.*	2005	Malaysia tropical forest conservation project report of the Perhentian phase 2005

Based on the studies of butterflies on islands, it was shown that butterfly species on offshore islands are slightly different compared to mainland in terms of pattern, size and colors. For instance, Wilcocks (1969) stated that there was difference between the male and female butterflies on Pulau Langkawi compared to the mainland (Kedah). The male *Poritia erycinoides* is distinctly green in color compared to mainland which is obviously blue. The mainland female exhibits more orange in color by predominantly brown upperside than any of the butterflies on Langkawi. The butterfly composition between Langkawi and the mainland is also different. Some butterflies occur on Langkawi but not in Kedah, such as *Doleschallia bisaltide siamens* (Nymphalidae) and *Arhopala atosia jahara* (Lycaenidae).

Pasteur (1972) continued the study of butterflies by Wilcocks (1969) on Pulau Langkawi in a different season. He discovered the female specimens of certain species such as *Rhinopalpa*, *Moduza*, *Doleschallia*, *Polyura* and *Charaxes* species on Langkawi were less common on the mainland compared to the male individual. A first record of *Charaxes solon echo* from Langkawi was also documented.

Stubbs (1961) conducted a butterfly survey on Pulau Tioman and Pulau Aur as well as with the adjacent mainland. He discovered that the race of species from Pulau Tioman is intermediate between the mainland form and from Pulau Aur. The male *Cepora iudith siamensis* from Pulau Aur is much lighter than the mainland race with the underside hind wing is mostly white with a small yellow area. The race from Pulau Pemanggil is similar to *siamensis* but is rather less extreme. The Pulau Tioman race, *Cepora iudith talboti* is nearer to the mainland race rather than to *siamensis*.

Studies done by Pendlebury and Museums (1931) and Abang *et al.* (2006) in Borneo and Quek *et al.* (1999) in Peninsular Malaysia indicated that species will slowly evolve in order to adapt to the changes of environment especially on more remote regions such as island. Pendlebury and Museums (1931) stated that sixteen species of butterflies were collected on Mangalum Island, a small size island that consists of various restricted fauna. One species (*Libythea geoffery*) was known from Borneo mainland and belonged to Austro-Oriental but had a continental branch in Tenasserim and states of Laos. They captured species from family Papilionidae, *Papilio empedocles* which was rare on Borneo but common on Mangalum.

On the Balambangan Island, on the West Coast of Sabah, Abang *et al.* (2004; 2006) studied 150 butterfly species collected over a period of three years. Out of 150 butterfly species collected, 22 were subspecies of N. Borneo, 10 were subspecies of the Philippines and 44 were subspecies of N. Borneo to Philippines whereas 26 were assumed as endemic species to Balambangan or Balambangan and Banggi. Altogether, 19 were new subspecies .

Quek *et al.* (1997) conducted butterfly study on Pulau Tioman. Twenty-five out of 78 species were possibly new records. There were also some subspecies endemic to this island such as *Phalanta alicippe tiomana* and *Vindula dejone tiomana* (Nymphalidae) and *Caleta elna epeus* (Lycaenidae). They also stated that the subspecies presented on the island of Peninsular Malaysia were generally closer in appearance to the subspecies in Borneo.

Other studies of Rhopalocera on offshore islands were carried out by Zaidi and Salleh (1997), Liow (1998), Zaidi and Soh (2000), Turner *et al.* (2003) and Tamblyn *et al.* (2005). Zaidi and Salleh (1997) collected thirty-six species with 83 individuals from the family Papilionidae, Pieridae, Nymphalidae and Lycaenidae on Pulau Banggi. *Ideopsis vulgaris interposita* (Nymphalidae) was the most abundant species with the total of ten species while *Drupadia theda thesmia* (Lycaenidae) was the least abundant with only one species sampled.

Liow (1998) collected seven butterfly species on Pulau Tulai, 12 on Pulau Sribuat-Sembilang and 24 on Pulau Pemanggil during the surveyed on these islands. There were also 20 new records of species on Pulau Pemanggil such as *Pachliopta aristolochiae asteris*, *Papilio polytes romulus* and *Appias paulina distanti* (Liow, 1998).

On the Pulau Pinang, Terengganu, a total of 31 species with 35 individuals were collected by Zaidi and Soh (2000). Out of the four families, Nymphalidae had the highest number of individuals which is 18. Papilionidae and Pieridae consisted of four individuals each whereas nine individuals from Lycaenidae. *Ideopsis juventa sitah* was the most abundant species with eight individuals collected respectively.

Turner *et al.* (2003) collected a total of 378 butterflies during the study on Pulau Redang. Out of this, 32 species were recorded across the eleven study sites. In comparison the list of Lepidopteran species between Pulau Redang and Pulau Perhentian, there were limited number of species occurred on Pulau Perhentian. Both

islands shared some common species such as *Graphium sarpedon* (Papilionidae), *Eurema hecabe* (Pieridae), *Cyrestis themire* (Nymphalidae) and *Chilades pandava* (Lycaenidae). Species from the family Hesperiidae were found on Pulau Redang but not on Pulau Perhentian. Examples of species from family Hesperiidae in Pulau Redang were *Hasora badra*, *Matapa druna*, *Parnara naso* and *Pelopidas distanti*.

Butterfly research done by Tamblyn *et al.* (2005) on three islands namely Pulau Redang, Pulau Perhentian and Pulau Tioman showed that Pulau Redang had the highest number of species (84 species) whereas Pulau Perhentian and Pulau Tioman had 61 and 76 species respectively. The three islands also shared some common species such as *Papilio polytes* (Papilionidae), *Catopsilia pomona* (Pieridae), *Cupha erymanthis* (Nymphalidae) and *Anthene emolus* (Lycaenidae). Nymphalidae had the highest number of species followed by Lycaenidae while the family Papilionidae had the lowest number of species across all the East Coast Islands

Based on the study done by Yeh (1972) in Ulu Piah, Perak, short-term migration often happened among butterflies especially family Papilionidae, Pieridae and Nymphalidae. New species records of butterflies were also discovered. *Papilio memnon agenor* was known only to exist in Singapore at the Tapah Hill Reserves. *Graphium macareus* (Papilionidae), *Appias paulina* (Pieridae) and *Euthalia dunya* (Nymphalidae) were Kedawi (areas comprising Pulau Langkawi, Perlis and North of Kedah) species but were found abundant in Ulu Piah area especially in the months of June and July.

Thus, previous studies concerning butterflies on islands in Malaysia are important. The study of islands is a fundamental for understanding of the emerging patterns of butterfly species mainly in speciation, butterfly biodiversity and the need to conserve them. Results from the current study will be compared with such studies particularly in terms of the butterfly composition, endemism and also the uniqueness in species.

3.0 MATERIALS AND METHODS

3.1 Study sites

Pulau Satang Besar (01°46'50.0"N and 110°09'38.5"E) (Figure 1) is the first Marine National Park in Sarawak. This island of the southwestern coast of Sarawak covers an area of approximately 9,894 hectares which comprises of planted vegetation, open shrub land, beach forest, secondary with little primary forest (Hazebroek and Morshidi, 2000).

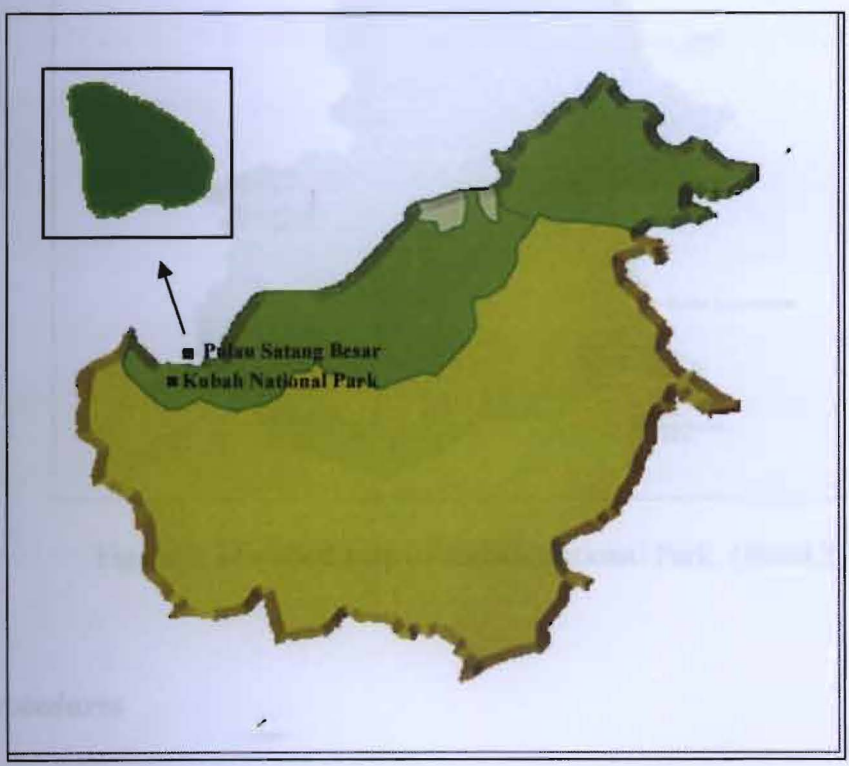

Figure 1: Modified map of Pulau Satang Besar and Kubah National Park, Borneo (Anon 1).

Kubah National Park (01°36'48.43"N and 110°11'51.59"E) (Figure 1) is one of the most accessible national parks in Sarawak that covers a total area of approximately 2,230 hectares. Kubah National Park comprises of five types of forest which are alluvial, lowland mixed dipterocarp, kerangas, submontane and secondary forest (Lee, 1987; Pearce, 1994).

Figure 2: Modified map of Kubah National Park. (Anon 2)

3.2 Procedures

3.2.1 Sampling

A preliminary survey on butterflies was carried out from 27th August till 1st September 2006 and 9th September till 11th September 2006 on Pulau Satang Besar followed by a second survey conducted from 19th December till 27th December 2006

at Kubah National Park. All these samplings were collected for nine days each along the man-made trails.

Sampling was done using a line transects method on two trails on Pulau Satang Besar, Trail 1 (01°47'07.8"N; 110°09'32.9"E) and Trail 2 (01°47'1.66"N; 110°09'42.6"E) with a total distance of 5km per day and a total man effort of 16 daily for nine days.

In Kubah National Park, five trails were surveyed, namely Waterfall trail, Rayu trail, Main trail, Belian trail and Summit trail (Figure 2) with a total of 5km of line transect and 16 daily man effort for nine days.

Most of samplings were conducted between 0800am till 0600pm. Captured butterflies were paralyzed or killed by exerting a light pressure from the thumb on the thorax (Daccordi *et al.*, 1988) and then stored in prefolded paper triangles with labels. Baited traps were set up in places with moderate light intensity and the distance between one another was around 10m. In this study, pineapple were cut into small pieces and used as bait.

All the specimens were brought back to the Faculty of Resource Sciences and Technology Museum (Insect Reference Collection) for further preservation.

3.2.2 Setting

All specimens were relaxed prior to setting. Setting is a process of pinning butterflies and drying them into permanent standardized posture (Fres, 1991). Butterflies were pinned in the center of the thorax to ensure that the body is at the right angles to the pin. Insect pins according to the size of insects were used during pinning process. Each wing was gently eased into the correct position by the help of insect pin and covered with paper strips, preferable gap 1 cm from the groove. Lastly, antennae were arranged in the form of 'v' shape in line with the fore wings. The specimens were kept at room temperature for a week before storing in insect drawers.

3.2.3 Identification

All species were identified using available references such as Aoki *et al.* (1982), Otsuka (1988), Maruyama and Otsuka (1991), Seki *et al.* (1991) and Abang (2006) as well as comparing with the available voucher specimen in the Unimas Insect Reference Collection.

4.0 RESULTS AND DISCUSSION

4.1 Butterfly composition

Altogether, 112 species and 369 individuals were collected on Pulau Satang Besar and at Kubah National Park. Of these, thirty-five species with 157 individuals from five families were collected on Pulau Satang Besar while a total number of 212 individuals representing 86 species were captured at Kubah National Park (Figure 3).

This shows that Kubah National Park is more speciose in terms of its butterfly composition as compared to Pulau Satang Besar. According to Mac Arthur and Wilson (1969), the larger the island, the larger the number of habitats and consequently accommodate more species. Pulau Satang Besar is smaller in size as compared to Kubah National Park, therefore it is less diverse in habitats and thus accommodate poorer species composition as compared to Kubah National Park.

With the exception of *Ideopsis juventa sitah* and *Euploea crameri* subspecies, all the species captured on Pulau Satang Besar are also found in Borneo although not all were sampled from Kubah National Park. Results from the study indicate that the butterfly fauna on Pulau Satang Besar is different in composition from Kubah National Park. Nevertheless, ten species were shared by the two study sites including species reported in previous documentation of the Kubah National Park butterfly (Appendix II) (F. Abang, *per. comm.*).